

[illegible]

**Figure 1**

[illegible][illegible][illegible][illegible]

Not only has switching technology undergone major changes, the type of traffic being carried on telephone lines has also changed dramatically. Although originally designed for voice traffic and "tuned" to operation in the voice band between approximately 350 and 4000 Hz, the telecommunications infrastructure also carries data, through the use of various channels, or tones. However, with the growing use of the Internet, and the potential development such high bandwidth applications such as interactive distance-learning and video on demand, the existing telecommunications infrastructure is in danger of being overwhelmed. A large portion of the system's transmission medium has been replaced with high speed trunks which employ fiber optic transmission media, microwave media, and line of sight optical media, for example, to meet the ever mounting demand for high speed data transmission capability. Data traffic is increasing at a rate of approximately 300% per year, while voice traffic is only increasing at the relatively slow rate of approximately 5% per year. However, a huge installed base of transmission media, switching devices, and other telecommunications infrastructure provide the telecommunications path for the vast majority of telecommunications providers and users.

A system and method that enable the efficient combination and management of circuit-switched and packet-switched facilities, thereby taking advantage of the tremendous installed base of equipment and facilities while, at the same time permitting an extensive upgrade of data facilities, which, typically employ packet switching systems would therefore be highly desirable.

#### **RELATED APPLICATIONS**

Patent Applications entitled, "Apparatus and Method For Synchronous and Asynchronous Switching of Internet Protocol Traffic", and "Apparatus and Method For Synchronous and Asynchronous Switching of ATM Traffic", filed on the same day as this application and assigned to the same assignees as this application is assigned are hereby incorporated by reference.

## SUMMARY

A telecommunications management system and method in accordance with the principles of the present invention includes facilities for managing telecommunications switching in a system that includes both circuit switching and packet switching facilities. The circuit switching facilities may use a Synchronous Transport Signal (STS) crossconnect with interfaces to SONET rings, for example, and the packet switching facility may switch IP packets and/or ATM cells. In one aspect of the invention, real-time traffic, such as voice traffic, may be separated from non-real-time traffic, such as Internet email traffic. Once separated, the real time traffic may be switched through a synchronous transfer mode (STM) switch fabric, which may also be referred to herein as a circuit-switched switch or time division multiplexed (TDM) switch fabric. The non-real-time traffic may be switched through a packet-switched switch fabric, such as an asynchronous transfer mode (ATM) switch fabric or an Internet Protocol (IP) switch fabric. For ease and clarity of description, packet switch fabrics, which may be either IP or ATM fabrics, will be referred to hereinafter as ATM switch fabrics.

In accordance with the principles of the present invention a hybrid switch includes packet and circuit switching switch fabrics, a hybrid switch manager and one or more input/output ports (I/O port). Telecommunications traffic enters the switch and, after the traffic is switched, departs to telecommunications network through the I/O port(s). In an illustrative embodiment, a SONET/SDH path layer overhead byte is employed to indicate to the hybrid switch manager which type of switch fabric, for example, STM or ATM, should be employed to switch the traffic associated with the SONET/SDH path layer overhead byte. This determination is made by the manager as the traffic arrives at the I/O port. Because the traffic load is shared, in parallel fashion, between the STM and ATM fabrics, neither switch need be of sufficient magnitude to accommodate the entire traffic load. In an illustrative embodiment the C2 byte within a SONET/SDH path overhead is used to indicate whether the associated traffic is to be routed to an STM, an IP and/or an ATM switch fabric.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above and further features, aspects, and advantages of the invention will be apparent to those skilled in the art from the following detailed description, taken together with the accompanying drawings in which:

Figure 1 is a conceptual block diagram which illustrates a network of hybrid switches in accordance with the principles of the present invention;

A hybrid telecommunications switch in accordance with the principles of the present invention includes both circuit switching and packet switching facilities and a management system and method for allocating traffic among the switching facilities. The circuit switching facilities may employ a Synchronous Transport Signal (STS) crossconnect with interfaces to SONET rings, for example, and the packet switching facility may use an ATM switch fabric for switching traffic in the form of ATM and/or IP packets or cells. In one aspect of the invention, traffic for which circuit switching may be more appropriate may be separated from traffic that is more suitably handled by packet switching facilities. That is, for example, real-time traffic, such as voice traffic, may be more appropriately handled by a circuit switching facility, and non-real-time traffic, such as Internet email traffic, may be more suitably handled by a packet switching facility. After separation, the real-time traffic may be switched through an STM switch fabric and the non-real time traffic, which may be ATM or IP traffic, may be switched through a packet switch fabric.







at the I/O port. In an illustrative embodiment, the C2 byte within a SONET/SDH path overhead is used to indicate whether the associated traffic is to be routed to an STM, an IP and/or an ATM switch fabric. The C2 byte within a SONET/SDH path overhead indicates a synchronous payload envelope (SPE) construction type. For example:

C2 = 14(hex), SPE is carrying DQDB traffic

C2 = 15(hex), SPE is carrying FDDI traffic

C2 = 04(hex), SPE is carrying DS3 traffic

C2 = 13(hex), SPE is carrying ATM traffic

C2 = cf (hex), SPE is carrying PPP (IP) traffic

The process of operating a hybrid switch in accordance with principles of the present invention is set forth in the flow chart of Figure 3 in which the process begins in step 300 and proceeds to step 302. In step 302 the switch fabrics, for example the local STM switch fabric 242 and the central packet switch fabric 232 of Figure 2, are provisioned. In the process of provisioning, shelf controllers, such as the shelf controller 226 of Figure 2, are instructed that STM crossconnect entries, related to local TDMs such as TDM crossconnect 242, for example, will be set aside for traffic that is to be routed to a packet switch (which may include ATM and/or IP traffic). The remaining crossconnect entries are to be used to switch STM traffic. The STM traffic may be "real-time" traffic, such as voice or video-on-demand, for example, and the packet switched traffic may be less time-critical traffic, such as email. The STM crossconnect will also be used to switch back-hauled data traffic, that is, traffic that is at an intermediate stop on a "multi-hop" path and is better suited for delivery through an STM crossconnect than a packet switch since the traffic is merely "bypassing". Additionally, the packet switch (which may include both IP and ATM switching facilities) is configured to track the sequence of incoming ATM/IP traffic in order to recognize ATM/IP traffic (through examination of the C2 byte) routed from a local STM switch such as the switch fabric 242 of Figure 2. In an IP switch, the provisioning entails port provisioning. In an ATM switch, a connection table and virtual path identifier/virtual channel identifier (VPI/VCI) space is provisioned.



and described to best explain the principles of the invention and its practical application, and to thereby enable others skilled in the art to best utilize the invention. It is intended that the scope of the invention be limited only by the claims appended hereto.

What is claimed is:

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